MEC-E1030 - Random Loads and Processes

Exam, 03.12.2024, Otakaari 4, 213a, 09:00-12:00 Mashrura Musharraf

Question 1. Deterministic vs. random Loads

A. Explain the deterministic and random loads for your engineering problem (the problem you used in the weekly assignments). What is the primary difference between how you measure deterministic vs. random loads? **2p**
B. Correlation, covariance, and correlation coefficient are 3 different ways to measure the relationship between two random variables. Correlation coefficient is frequently more used than the other two. Why? **2p**
C. What is an autocorrelation function, explain its role in the identification of narrow and broad band random processes. **2p**

Question 2. Mathematics of Random Process

A. What is an ergodic process? How would you evaluate if a random process is ergodic? **2p**
B. What is the key difference between a histogram and a probability density function (PDF)? Which one is more useful in the analysis of random process? Why? **2p**
C. How would you interpret a long tail in a PDF? Would a long tail influence any steps of the big picture of design? How? **2p**

Question 3. Environmental Loads and Responses

A. Describe the physical process of how the random load in your application case forms (i.e., what causes the random nature, how random is it etc.). **2p**
B. Fast Fourier Transform (FFT) and Power Spectral Density (PSD) both represent the frequency content of the data. Which one did you use for your engineering problem (the problem you used in the weekly assignments)? Why? **2p**
C. A given time history has a unique PSD, but a given PSD does not have a unique time history, why? **2p**

Question 4. The big picture of design process

A. Explain the roles of short- and long-term assessment of random loads? How are these related? **2p**
B. For a stationary Gaussian stress process, calculate the probability that stress will exceed three times its RMS values. Clearly mention your assumptions. **2p**
C. What assumptions need to be valid for you to have a direct link between the frequency and probability domain? How would you validate these assumption? **2p**